I-75 Modernization Traffic Noise Analysis Segment 12

Oakland County, Michigan

Project Description

The I-75 roadway improvement project is located in Oakland County, Michigan. The February 2015 Noise Report represents an update the FEIS study document completed in May 2005. The present analysis addresses updates to the Michigan Department of Transportation (MDOT) traffic noise policy guidelines and impact criteria that became effective in 2011. These policy changes are outlined in the July 2011 *MDOT Highway Noise Analysis and Abatement Handbook*. In addition to the policy updates, future predicted noise levels were determined using Federal Highway Administration (FHWA) TNM 2.5 model rather than the TNM version 2.1 used during the FEIS phase. A map of the overall project study area is illustrated in Figure 1 with Segment 12 shown in the upper left hand corner. As depicted in Figure 2, Segment 12b is bounded by Coolidge Highway on its eastern most extent to Adams Road on its most western terminus.

Figure 1
TNM Modeling Segments

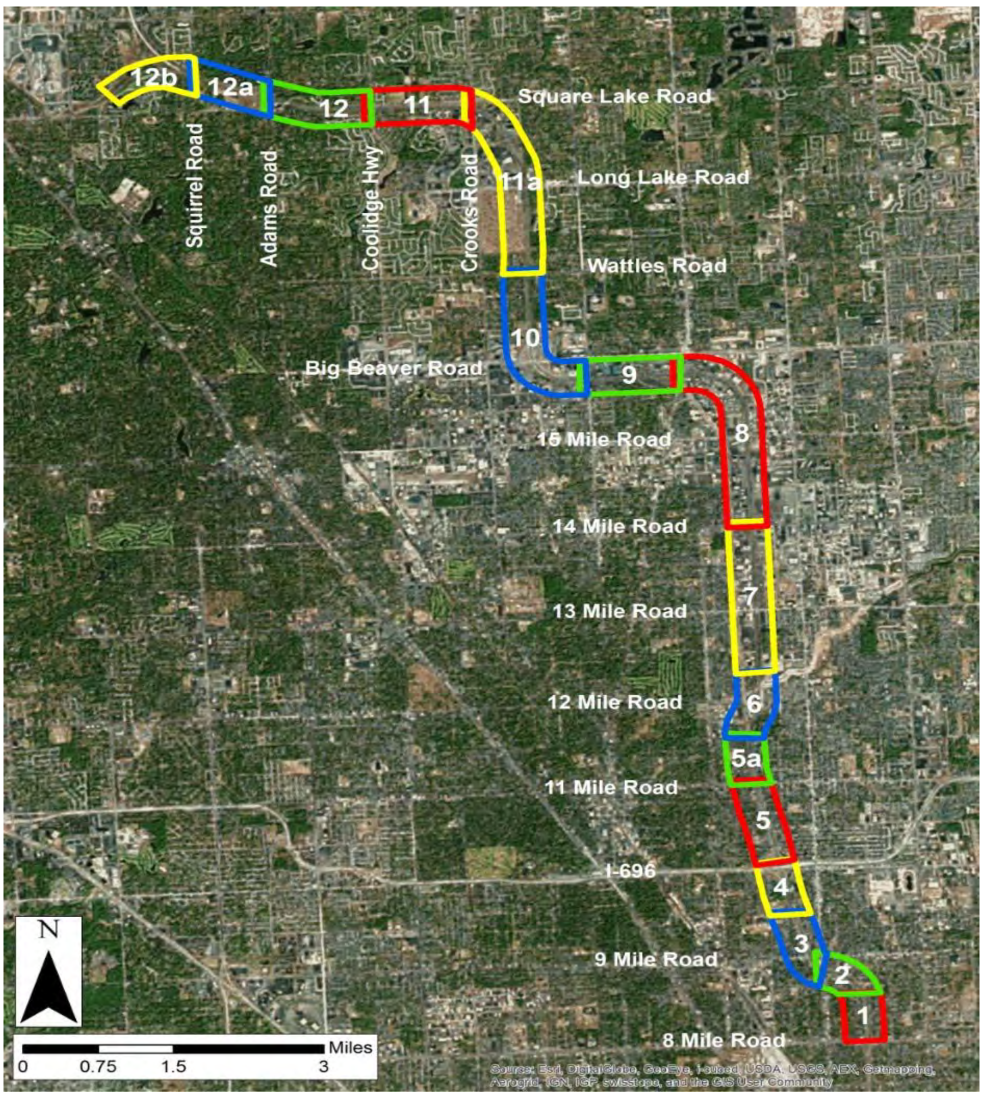


Figure 2 Segment 12 Noise Monitoring Site

FUNDAMENTAL CONCEPTS OF ROADWAY NOISE

Sounds occur in the human and natural environment at all times. Some sounds are necessary or desirable for communication or pleasure, some are unnoticed and other sounds are unwanted, causing annoyance and disturbance to the people living or working in the area. Therefore, by definition, unwanted sound is referred to as noise. The following sections provide a background for some of the physical properties and terminology of sound and noise.

A-Weighted Sound Level

The most commonly used measure of noise level is the A-weighted sound level (dBA). From many experiments with human listeners, scientists have found that unlike animals the human ear is more sensitive to midrange frequencies than it is to either low or very high frequencies. At the same sound level, midrange frequencies are therefore heard as louder than low or very high frequencies. This characteristic of the human ear is taken into account by adjusting or weighting the spectrum of the measured sound level for the sensitivity of human hearing range. The A-weighted sound level is a measure of sound intensity with one-third octave frequency characteristics that correspond to human subjective response to noise weighted. The A-weighted sound level is widely accepted by acousticians as a good descriptor for assessing human exposure and annoyance from environmental noise. Figure 3 illustrates some common A-weighted noise levels.

An understanding of the following relationships is helpful in providing a subjective impression of changes in the A-weighted sound level:

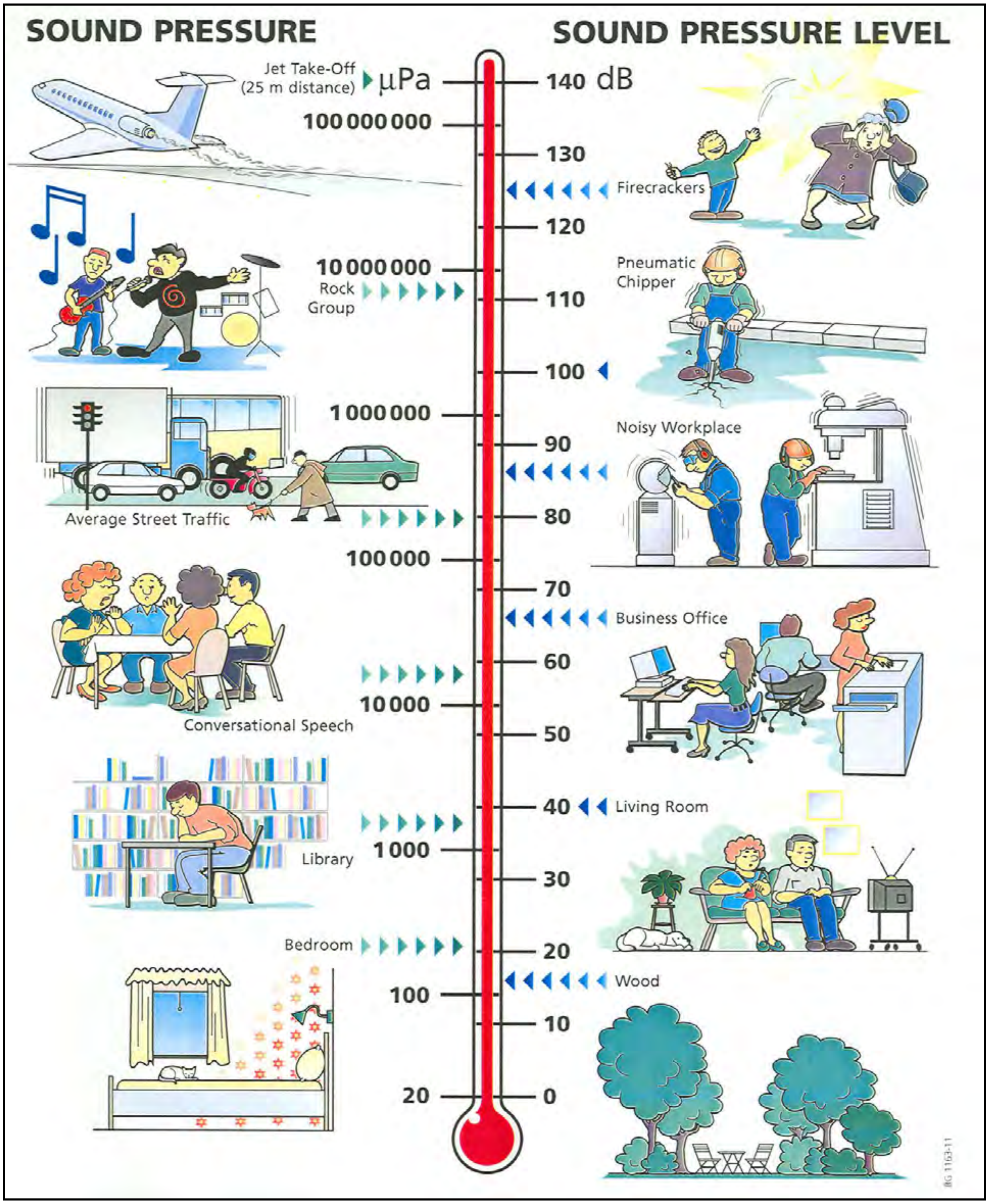
- Except in carefully controlled laboratory experiments, an increase of only 1 dB in A-weighted level cannot be perceived.
- Outside of the laboratory, a 3 dB increase in A-weighted level is considered a just-noticeable difference.
- A change in A-weighted level of at least 5 dB is required before any significant change in the noise level in a community is perceived.
- A 10 dB increase in A-weighted level is subjectively heard as approximately a doubling in loudness, independent of the existing noise level.

Sound Level Descriptors

The third basic parameter of environmental noise is its time-varying character. The sound level from any roadway fluctuates from moment to moment as time passes. These fluctuations constitute the time-varying properties of roadway noise.

Because environmental noise fluctuations vary from moment to moment, it is common practice to condense all of the information into a single number, called the “equivalent” sound level (L_{eq}). The L_{eq} is a measure of the average sound energy during a specified period of time (typically 1 hour duration). The L_{eq} is defined as the constant level that, over a given period of time, transmits the same amount of acoustical energy to the receiver as the actual time-varying sound. Studies have shown that L_{eq} noise descriptor is well correlated with human annoyance to sound; therefore, this descriptor is widely used for environmental noise impact assessments. The L_{eq} measured over a one-hour period is the hourly L_{eq} (1-hour), which is used to analyze highway traffic noise impacts and abatement acoustic effectiveness.

Figure 3 Typical Noise Levels



Existing Ambient Noise Levels

Existing ambient noise levels were measured at one representative receptor site identified within the Segment 12 study area. Ambient levels were recorded at measurement site R26 as shown in Figure 2 and summarized below in Table 1. Measured ambient noise levels were collected during the peak AM 7-8 AM time period and were found to be slightly above the MDOT 66 dBA impact threshold.

Table 1

Summary of Measured Noise Levels in Study Segment 12

Receptor	Location	Date	Land Use Type	Time of Noise Reading	Measured Leq (1hr) dBA
R26	26 Andover Drive at Arland Way	5-29-14	Single Family Residential	7:26 AM to 7:41 AM	67.4

Future 2035 Build Conditions Noise Level Estimates

Figure 4 depicts the receiver sites modeled for future noise impact exposure within the Segment 12 community. As indicated by the red dots in Figure 4 the noise analysis found 24 impacted receivers. A summary table of future 2035 Build noise levels at each modeled receiver in the Segment 12 community is provided in Table 2. TNM predicted noise levels at or above the MDOT 66 dBA impact threshold are shown in bold text.

Future 2035 Build Conditions With Abatement

A noise barrier analysis was completed to evaluate the feasibility and reasonableness of placing sound barriers along both the southbound and westbound sides of I-75. The modeled sound barriers are depicted in Figure 5 by the four solid red lines depicting the two southbound and two northbound proposed sound barriers. The two south bound sound barriers are treated as a single system of abatement and similarly the two northbound barriers are treated likewise as a single system. The findings indicate that neither the northbound or the southbound barriers achieve a reasonable cost. Cost effectiveness per benefitted receiver far exceeded MDOT $44,187 maximum cost per benefit. In addition the northbound barriers failed to achieve adequate noise reduction with too few impacted receivers (only 40%) achieving MDOT’s required 5 dB minimum noise reduction.

Conclusion

The study findings indicate that there will be 24 impacted properties under the 2035 future build traffic conditions. The noise abatement analysis found that both the southbound and northbound sound barrier systems (as depicted in Figure 5) would far exceed MDOT maximum cost per benefitted receiver of $44,187. Along the southbound I-75 roadway receivers costs per benefitting receiver were determined to exceed $100,000 per benefit and over $400,000 per benefit along the proposed northbound side barriers. Furthermore, there were insufficient number of impacted properties which achieved the MDOT required 5 decibel noise reduction. Therefore the Segment 12 sound barriers failed to achieve adequate noise reduction and cost effectiveness as defined by MDOT feasibility and reasonableness guidelines to be considered viable to be built.

Figure 4
Segment 12 Summary of Impacted Receivers

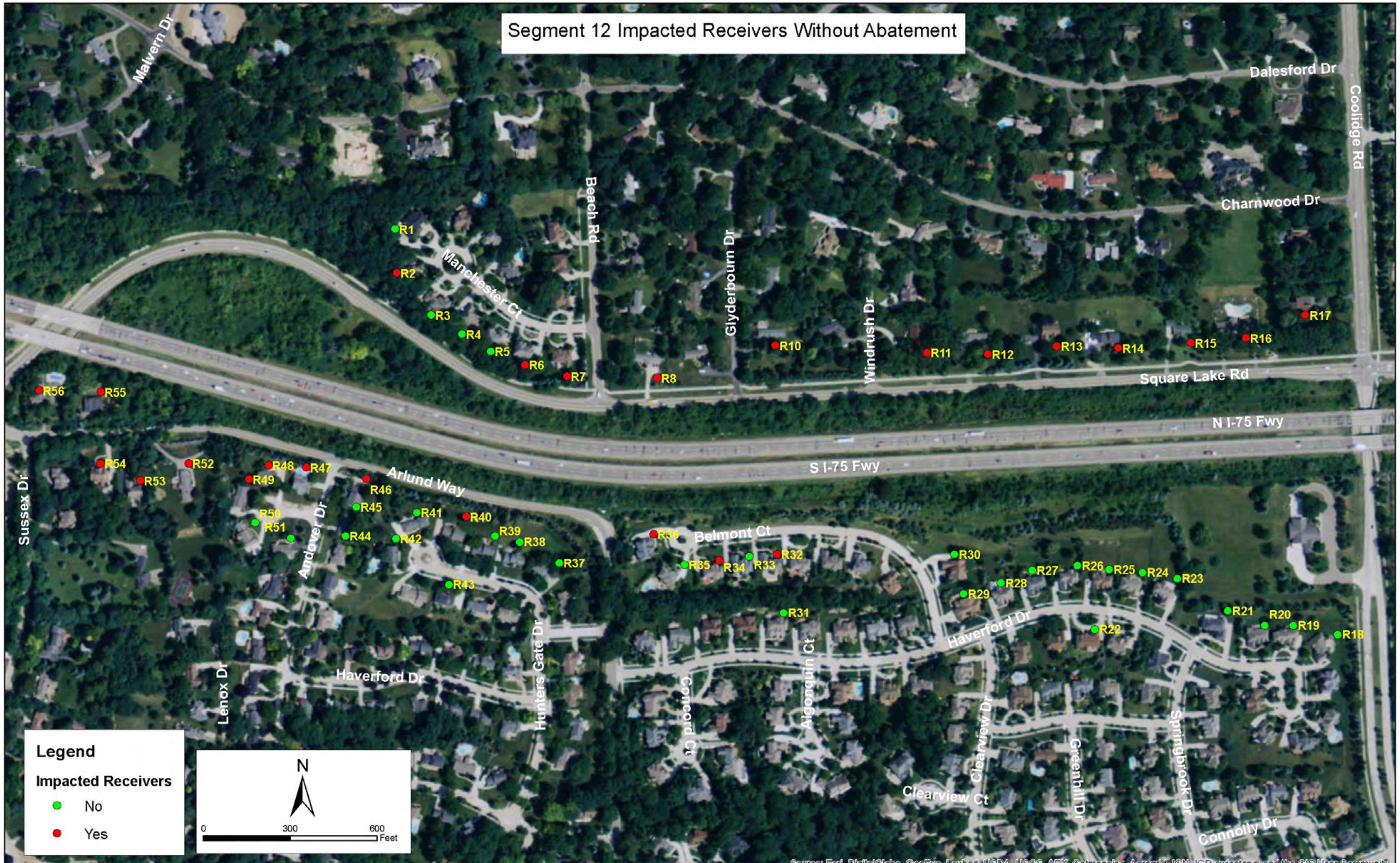


Figure 5
Segment 12 Summary of Benefitted Receivers

Table 2
Segment 12 Summary of Predicted Future Build Noise Levels Without & With Abatement

Receptor ID	Predicted 2035 Build Noise Levels Without Abatement Leq (1 hr) dBA	MDOT/FHWA Impact (YES/NO)	Predicted 2035 Build Noise Levels With Abatement Leq (1 hr) dBA	MDOT/FHWA Impact (YES/NO)	Noise Reduction Level Achieved with Abatement (dBA)
Receiver1	64.5	No	64.3	No	0.2
Receiver2	**66.9**	**Yes**	66.9	No	0
Receiver3	62.5	No	62.5	No	0
Receiver4	62.7	No	62.6	No	0.1
Receiver5	65.3	No	65.3	No	0
Receiver6	**67**	**Yes**	66.8	No	0.2
Receiver7	**69.3**	**Yes**	69	No	0.3
Receiver8	**73.7**	**Yes**	71.8	No	1.9
Receiver10	**69.2**	**Yes**	62.4	**Yes**	**6.8**
Receiver11	**69.8**	**Yes**	63.8	**Yes**	**6**
Receiver12	**71.7**	**Yes**	64.5	**Yes**	**7.2**
Receiver13	**69.9**	**Yes**	64.3	**Yes**	**5.6**
Receiver14	**68.5**	**Yes**	64.6	No	3.9
Receiver15	**67.4**	**Yes**	63.9	No	3.5
Receiver16	**67.2**	**Yes**	63.7	No	3.5
Receiver17	**66.2**	**Yes**	62.3	No	3.9
Receiver18	59.2	No	59.2	No	0
Receiver19	55.9	No	55.9	No	0
Receiver20	56.9	No	56.9	No	0
Receiver21	61.8	No	61.8	No	0
Receiver22	56.9	No	56.9	No	0
Receiver23	62.7	No	62.7	No	0
Receiver24	61.2	No	61.2	No	0
Receiver25	59.4	No	59.4	No	0
Receiver26	59.5	No	59.5	No	0
Receiver27	58.6	No	58.6	No	0
Receiver28	57.2	No	57.2	No	0
Receiver29	57.7	No	57.7	No	0
Receiver30	59.2	No	59.2	No	0
Receiver31	64.4	No	64.4	No	0
Receiver32	**67.1**	**Yes**	67	No	0.1
Receiver33	65.6	No	65.3	No	0.3
Receiver34	**66.5**	**Yes**	66.2	No	0.3
Receiver35	64.6	No	64.2	No	0.4

Table 2
Segment 12 Summary of Predicted Future Build Noise Levels Without & With Abatement

Receptor ID	Predicted 2035 Build Noise Levels Without Abatement Leq (1 hr) dBA	MDOT/FHWA Impact (YES/NO)	Predicted 2035 Build Noise Levels With Abatement Leq (1 hr) dBA	MDOT/FHWA Impact (YES/NO)	Noise Reduction Level Achieved with Abatement (dBA)
Receiver36	**66.3**	**Yes**	65	No	1.3
Receiver37	63.8	No	61.8	No	2
Receiver38	65.7	No	60.3	**Yes**	**5.4**
Receiver39	66.3	No	60.5	**Yes**	**5.8**
Receiver40	**67.3**	**Yes**	60.3	**Yes**	**7**
Receiver41	65	No	59.7	**Yes**	**5.3**
Receiver42	59	No	54.0	**Yes**	**5.0**
Receiver43	56.6	No	55.1	No	1.5
Receiver44	57	No	54.6	No	2.4
Receiver45	55.8	No	50.4	**Yes**	**5.4**
Receiver46	**71.9**	**Yes**	63.3	**Yes**	**8.6**
Receiver47	**72.4**	**Yes**	63.2	**Yes**	**9.2**
Receiver48	**71.7**	**Yes**	61.7	**Yes**	**10**
Receiver49	**69.4**	**Yes**	60.1	**Yes**	**9.3**
Receiver50	63.1	No	56.3	**Yes**	**6.8**
Receiver51	61.8	No	54.9	**Yes**	**6.9**
Receiver52	**70.7**	**Yes**	60.8	**Yes**	**9.9**
Receiver53	**66.6**	**Yes**	58.4	**Yes**	**8.2**
Receiver54	**67.2**	**Yes**	62.3	No	4.9
Receiver55	**75.9**	**Yes**	67.6	**Yes**	**8.3**
Receiver56	**68.1**	**Yes**	66.9	No	1.2